Quarterly Activities Report for July - September 1993
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NEAR TERM OBJECTIVES

Preparation for First Software Delivery. The cloud algorithms outlined in
the ATBD on "Cloud Properties" will be prepared with benchmark data sets
(from HIRS and MAS) and delivered to SDST early next year. The
"Atmospheric Profiles" algorithms will be sent somewhat later. Transfer of
all related subroutines from the McIDAS mainframe to the RISC
environment will be completed. Hardware capabilities for the MODIS team
at the University of Wisconsin will be enhanced to facilitate the software
transfer.

Algorithm Definition. Using the MAS data from FIRE in Nov- Dec 1991,
TOGA COARE in Jan Feb 1993, and SCAR-A in Jun-Jul 1993, the algorithms
for specifying cloud parameters (mask, temperature, phase, height, and
amount) will continue to be investigated. Algorithms for atmospheric total
column amount (ozone, precipitable water vapor, and stability) and
profiles (temperature and moisture) will be developed using the HIRS
(High resolution Infrared Radiation Sounder) data from these field
experiments and beyond.

Cloud Mask Input. Based on MAS, HIRS, and GOES cloud investigations,
suggestions for infrared screening for clouds will continue to evolve and be
forwarded to the MODIS Calibration Support Team. An ATBD will be
drafted in coordination with Ron Welch, Bryan Baum, and John Barker.

Definition of MODIS Infrared Calibration. The calibration of the MODIS
infrared channels will continue to demand attention. Simulations of the
impact of spectral channel changes on the cloud parameter derivation
should continue to guide instrument developers.

ACCOMPLISHMENTS

ATBDs Submitted. Two Algorithm Theoretical Basis Documents on Cloud
Top Properties and Atmospheric Profiles were submitted in the last
quarter. The first includes cloud top pressure, emissivity, fractional
coverage, and phase to be produced globally at 5 km resolution. The
second includes determinations of clear column atmospheric stability, total

ozone, and total precipitable water, as well as temperature and moisture profiles also at 5 km resolution.

TOGA/COARE Activities. MAS data collected during TOGA/COARE are being separated into straight-line flight tracks, navigated and archived in the University of Wisconsin's (UW) McIDAS format. Archived navigated imagery facilitates efficient utilization of the MAS data sets with TOGA/COARE data sets from other platforms. The TOGA/COARE flights identified as priority days (Jan 26, Feb 24, Jan 12, Feb 1, Feb 9) by the radiation group at July's TOGA/COARE workshop (attended by Chris Moeller) are being processed. As these data are processed, a cloud catalogue of each data set is being generated. The catalogue includes low, middle, high and total cloud fraction, albedo, cloud top height and temperature, connectivity, and multilayering. Also discussed at the TOGA/COARE workshop, a complete MAS TOGA/COARE data set (all flight days) will be processed by the MODIS Science Data Support Team at GSFC and archived for distribution by EOS Distributed Active Archive Center (DAAC) User Support Office. The goal is to have the data available by Jan 1, 1994. Lidar data collected simultaneously with the MAS data on the NASA ER-2 platform will be obtained for verification of MAS CO_2 cloud height estimates; microphysical in situ data collected from the NASA DC-8 platform will aid in cloud particle phase studies. A presentation of preliminary MAS TOGA/COARE cloud study results was made at the workshop.

SCAR Data Processing. MAS data collected during the SCAR-A field program in July (July 12, 14, 16, 20, 22, 25, 28) is being received and processed into straight line flight tracks on the McIDAS system at the University of Wisconsin (UW). UW will focus on cirrus cloud studies (CO_2 cloud height/emissivity, cloud particle phase, cirrus detection). Clear scenes from the July 16 MAS SCAR-A data set yielded the following noise quantities: signal to noise for the visible channels was 85 for .55 um, >100 for .66 um, >100 for .87 um, >100 for .94 um, 20 for 1.88 um, >100 for 2.14 and noise equivalent temperature error for the infrared channels at 300 K was 0.72 C for 3.7 um, 0.25 C for 8.6 um, 0.26 C for 11.0 um, 1.41 C for 13.2 um, and 0.34 C for 12.0 um. Noise determinations used clear scene signal over water. These noise numbers are in line with expectations. An absolute visible calibration during SCAR-A using the Goddard Space Flight Center (GSFC) integrating sphere will be obtained in the next quarter and used to calibrate the visible channels. The MAS and AVHRR data of July 14, which includes multilayer and high cloud scenes is currently being used for cirrus cloud studies. A 3 channel (vis, nir, thermal) cirrus detection algorithm under development will be tested on this data set in the next quarter.

Additional data sets of interest for cirrus cloud studies are the July 22 and 25 MAS flights. Because of a pixel smearing problem in channels 11 and 12 (13.2 um and 12.0 um), MAS data will be averaged over 5 X 5 boxes (250m X 250m) for quantitative multispectral applications using these channels.

Coordinating SCAR Research. A SCAR-A/SCAR-C meeting, held at GSFC on 15 September 1993, was attended by Elaine Prins. Discussions centered on the status of the data obtained during SCAR-A, preliminary results, data exchange protocol, collaborations on publications of results, and a tentative timetable for publication. The general feeling was to publish the SCAR-A results in a special issue of a yet unnamed journal, with an emphasis on the concept of the SCAR experiment series and SCAR-A results. The suggested timetable is as follows: exchange of available data by the end of this year, exchange of figures and preliminary results by March 1994, first draft of papers by May 15, 1994, and submit papers for publication by September 15, 1994. Suggested title topics for the Wisconsin group are: Review of the meteorological conditions and their relationship to SCAR-A missions and flight paths, the properties of the air mass, aerosol and clouds (Remer, Moeller, Kaufman, King, Hegg, et al.) and Remote sensing of cirrus clouds and their properties and structure during SCAR-A (Menzel, Moeller).

Support for SCAR-B Planning. Examples of aerosol transport associated with biomass burning in South America are being recorded. In response to a request by Yoram Kaufman, Elaine Prins is conducting a search for examples of aerosol transport in GOES imagery in 1983, 1988, 1989, and 1991 associated with biomass burning in South America under various meteorological conditions. The imagery will be used for planning future field experiments in Brazil. Hard copies of examples of aerosol transport in GOES imagery from each year are currently being produced.

GOES Study of Biomass Burning. In related work supported primarily by separate funding, an automated algorithm for detecting biomass burning and estimating the extent was developed. The VAS automated biomass burning algorithm was applied to GOES data over South America for two weeks of each burning season in 1983, 1988, 1989, and 1991. Diurnal variation in the detection of fires was reported. The areal extent of the burning was estimated. The expansion of the areas affected by burning over these nine years was obvious. A paper was submitted to JGR on this work.

Aerosol Detection. Steve Ackerman and Kathy Strabala demonstrated that the tri-spectral brightness temperature difference technique (8 minus 11

versus 11 minus 12 micron) is effective at detecting aerosols in the HIRS global data set from August 1990 and 1991. A definite decrease is apparent in the 8 minus 11 micron differences over low latitude clear sky oceans from the pre-Pinatubo to post- Pinatubo year, whereas the 11 minus 12 micron differences remained consistent. This implies that the 8 micron channel is sensitive to atmospheric aerosols and that the tri-spectral clear sky detection technique will not be affected by an increase in aerosols (the 8 minus 11 differences become more negative).

Clear Sky Determination. Kathy Strabala has applied the tri-spectral brightness temperature differencing technique for cloud phase delineation to four straight line flight tracks from the MAS TOGA/COARE 18 January 1993 data set. Each flight track consisted of different cloud regimes (water and ice cloud), over ocean water scenes which ranged from 27 - 31 degrees C. A clear sky 8-11 micron versus 11- 12 micron brightness temperature threshold was determined for each separate 10 by 10 FOV, based on the precipitable water versus sea surface temperature relationship described by Stephens (1990), and the resulting clear sky versus precipitable water regressions developed from global HIRS data sets. A bias adjustment was made to the thresholds to account for the differing spectral bandwidths of the HIRS and MAS instruments. Initial results are encouraging. Objective comparisons between the MAS coded clear scenes and visible channel images compared favorably. The advantage of this method of clear sky determination is that it requires no further spectral information beyond the three infrared channels used in the brightness temperature differencing. This new thresholding method will be tested further on the 1991 MAS FIRE data sets over the cooler waters of the Gulf of Mexico.

Application of an MLE. Tri-spectral brightness temperature differencing produces unique patterns of ice versus water cloud scenes in the brightness temperature difference scatter diagram. In an attempt to identify these characteristic patterns automatically, so that thresholding could be eliminated for single phase cloud scenes, a maximum likelihood estimator (MLE) is being tried. This entails using a least squares straight line fit to the 8-11 um versus 11-12 um data. All scenes with an 11 micron brightness temperature less than 240 K will not be included in the fit (these clouds are assumed to be ice cloud). If the fit is good, the slope of the line, and hence the phase, can be determined.

CERES Team Meeting. Paul Menzel attended the CERES Team Meeting and presented the theory of the CO_2 slicing algorithm and the results of application to four years of HIRS data. Further coordination on cloud property algorithms was planned.

Hardware Acquisition. An IBM RISC 6000 model 370 workstation has been ordered. This workstation will support MAS data set processing and science algorithm development and will serve as an environment for testing MODIS data applications. The continuing transfer of MAS processing and analysis code to the RISC environment on an "as needed" basis for the last 2 quarters will expedite the full utilization of this new workstation. The workstation will also be used as a data exchange conduit with the Science Data Support Team (SDST) at GSFC.

MODIS Briefing for NOAA/NESDIS. Paul Menzel briefed NESDIS management on the MODIS instrument, planned products, and possibilities for future NESDIS operations. This served as background material for NASA EOS-PM and NOAA polar metsat convergence discussions.

ANTICIPATED ACTIVITIES DURING THE NEXT QUARTER

Algorithm Preparation. Primary focus will be the transfer of the cloud algorithms outlined in the ATBD on "Cloud Properties" with benchmark data sets (from HIRS and MAS) to SDST early next year.

PROBLEMS/CORRECTIVE ACTION

None to report, although it still seems to be a good idea for SDST to conduct a site visit to see our local processing environment (McIDAS and RISC) and to clarify the algorithm sizing exercise.

PUBLICATIONS

Prins, E. M. and W. P. Menzel, 1993: Trends in South American Biomass Burning Detected with GOES VAS from 1983- 1991. submitted to Jour. Geo. Rev.

Wylie, D. P., W. P. Menzel, H. M. Woolf, and K. I. Strabala, 1993: Four Years of Global Cirrus Cloud Statistics using HIRS. submitted to Jour. Clim.

Strabala, K. I., S. A. Ackerman, and W. P. Menzel, 1993: Cloud Properties Inferred from 8-12 micron Data. accepted by to Jour. Appl. Meteor.